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Position Statement
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Visualization Research Challenges

We need a visualization **cookbook**: given this dataset and that task, how do we create interactive visualizations that are likely to be effective? A cookbook alone does not a good cook make: there is still considerable skill required to turn the instructions into something pleasant to eat. However, a step-by-step way to guide the explorations in the parameter space of possibilities provides a clear path by which novices can eventually become master cooks who can develop their own recipies. Without such a guide, an unprincipled exploration of the parameter space is often a frustrating exercise that quashes interest in the activity.

In the past 17 years, significant progress towards this goal has been made for the scientific visualization domains of isosurfaces, volume rendering, and flow data. In the newer realm of information visualization, where a much more diverse set of datasets and tasks are under consideration, we still have far to go in understanding the characteristics of effective visualizations and codifying this knowledge as design guidelines.

Questions about visual encoding are even more central to information visualization than to the somewhat older field of scientific visualization.The subfield names grew out of an accident of history and have some slightly unfortunate connotations when juxtaposed: information visualization isn't unscientific, and scientific visualization isn't uninformative.

Although not all of us agree on the distinction between the two, the definitions I'll use are that information visualization hinges on finding a spatial mapping of data that is not inherently spatial, whereas scientific visualization uses a spatial layout that's implicit in the data.

I believe that such a cookbook would bring us far towards the higher-level goal of **widespread adoption**. Currently, infovis has not yet broken out of its research roots into the mass market. There is a limited time window in which infovis will still be considered to have great promise; after that, if the promised breakout does not happen, we will be vulnerable to accusations that the field has been over-hyped.

Finally, **scalability** is a major challenge for infovis. One of the few things increasing more quickly than processor speed is the amount of data to be visualized. We must accept that any system we build will be used on datasets far larger than the intended purpose, and explicitly design in support for handling such loads gracefully. For example, rendering algorithms that provide a guaranteed frame rate provide interactive response even as a dataset grows large. Similarly, creating a spatial layout of an abstract dataset can be a time-consuming computation. Carrying out that computation incrementally allows users to immediately begin exploring a large complex dataset without waiting for the layout stage to complete. A further refinement is to allow the computation to be steerable.